

CLAIMS

1. An optical transmission system comprising at least a first and a second terminal station, optically connected with each other by an optical link, said first or said second terminal station being adapted to send on said optical link at least a first optical signal having a first direction, said system further comprising:
 - a first supervisory unit associated to a device disposed along said optical link, said first supervisory unit being adapted for generating a first supervisory signal, said first supervisory unit being further associated to at least one modulator being adapted to superimpose on said first optical signal said first supervisory signal;characterized in that said system further comprises:
 - at least one pump source disposed along said optical link, said pump source being adapted to send on said optical link a pump radiation in a second direction opposite to said first direction, so as to cause Raman amplification of said first optical signal and of said first supervisory signal superimposed on said first optical signal.
2. An optical transmission system according to claim 1, characterized in that said first supervisory signal comprises at least an information signal on an operating state of said device.
3. An optical transmission system according to claim 1 or 2, characterized in that said device disposed along said optical link is a repeater and said at least one pump source is comprised in said repeater.
4. An optical transmission system according to claim 3, characterized in that said first supervisory unit is associated to said pump source.
5. An optical transmission system according to any one of the preceding claims, characterized in that said modulator is a lithium niobate modulator.
6. An optical transmission system according to any one of claims 1 to 4, characterized in that said modulator is a semiconductor modulator.

7. An optical transmission system according to any one of claims 1 to 4, characterized in that said modulator is a tunable band-pass filter.
8. An optical transmission system according to any one of claims 1 to 4, characterized in that said modulator is a variable optical attenuator.
- 5 9. An optical transmission system according to claim 8, characterized in that said variable optical attenuator is a magneto-optical variable attenuator.
- 10 10. An optical transmission system according to any one of claims 1 to 4, characterized in that said modulator comprises an optical amplifier, and in that said first supervisory signal is adapted to modulate a gain of said optical amplifier.
11. An optical transmission system according to claim 10, characterized in that said optical amplifier is an erbium-doped fiber amplifier.
12. An optical transmission system according to claim 11, characterized in that said erbium doped fiber amplifier comprises at least one erbium-doped fiber and at least a further pump source adapted for emission of a pumping radiation for said erbium doped fiber, said first supervisory unit being associated to said further pump source, so that said first supervisory signal is adapted to modulate said pumping radiation for said erbium-doped fiber.
- 15 13. An optical transmission system according to claim 10, characterized in that said optical amplifier is a semiconductor amplifier
- 20 14. An optical transmission system according to claim 10, characterized in that said optical amplifier is a co-propagating Raman amplifier.
- 25 15. An optical transmission system according to claim 14, characterized in that said co-propagating Raman amplifier comprises at least a further pump source being adapted to send on said optical link a pumping radiation in said first direction, so as to cause Raman amplification of said first optical signal, said first supervisory unit being associated to said further pump source, so that said first supervisory signal is adapted to modulate said pumping radiation for Raman amplification.

16. An optical transmission system according to any one of the preceding claims, characterized in that said device further comprises at least one photodetector, being adapted to receive at least a portion of said first optical signal and transform said portion of first optical signal in an electrical signal.
- 5 17. An optical transmission system according to claim 16, characterized in that said first supervisory unit is associated to said photodetector and is adapted to discriminate a second supervisory signal carried by said first optical signal.
18. An optical transmission system according to claim 17, characterized in that said first supervisory unit is adapted to feed the discriminated second supervisory signal to said at least one modulator.
- 10 19. An optical transmission system according to any one of the preceding claims, characterized in that said optical link comprises at least a first optical fiber and a second optical fiber, said first optical fiber being adapted to carry said first optical signal in said first direction and said second optical fiber being adapted to carry a second optical signal in said second direction.
- 15 20. An optical transmission system according to claim 19, characterized in that said device comprises at least a second pump source, said second Raman pump source being adapted to send on said second optical fiber a pump radiation in said first direction, opposite to the direction of said second optical signal, so as to cause Raman amplification of said second optical signal.
- 20 21. An optical transmission system according to claim 19 or 20, characterized in that said device comprises at least a second modulator, said second modulator being associated to said first supervisory unit.
22. An optical transmission system according to claim 21, characterized in that said first supervisory unit is adapted for generating at least a third supervisory signal, and said second modulator is adapted for superimposing said third supervisory signal to said second optical signal.
- 25 23. An optical transmission system according to any one of claims 19 to 22, characterized in that said device comprises at least a second photodetector,

being adapted to receive at least a portion of said second optical signal and transform said portion of second optical signal in an electrical signal.

24. An optical transmission system according to claim 23, characterized in that said first supervisory unit is associated to said second photodetector and is adapted to discriminate a fourth supervisory signal carried by said second optical signal.

25. An optical transmission system according to any one of the preceding claims, characterized in that said first or said second terminal station comprises a second supervisory unit, being adapted to receive at least a portion of said first or said second optical signal from said optical link and discriminate from said first or said second optical signal said first or said third supervisory signal.

26. An optical transmission system according to claim 25, characterized in that said second supervisory unit is adapted to generate a fifth supervisory signal to be superimposed on said first or said second optical signal.

27. An optical transmission system according to any one of the preceding claims, characterized in that said first or said second optical signal is a WDM optical signal.

28. An optical transmission system according to claim 27, characterized in that said first or said second terminal station comprises a plurality of transmitters being adapted to emit a respective plurality of optical signals having different wavelengths, and a multiplexing device being adapted to multiplex said plurality of optical signal having different wavelengths in said WDM optical signal.

29. An optical transmission system according to claim 28, characterized in that said first or said second terminal station comprises a transmitter optical amplifier.

30. An optical transmission system according to claim 26 and 29, characterized in that said second supervisory unit is associated to said transmitter optical amplifier, so that said fifth supervisory signal is adapted to modulate a gain of said transmitter optical amplifier.

31. An optical transmission system according to claim 30, characterized in that said transmitter optical amplifier is a co-propagating Raman amplifier.
32. An optical transmission system according to any one of claims 26 to 29, characterized in that said first or said second terminal station comprises at least a third modulator, said second supervisory unit being associated to said third modulator in order to superimpose said fifth supervisory signal to said first or said second optical signal.
33. An optical transmission system according to claim 32, characterized in that said third modulator is a variable optical attenuator.
34. An optical transmission system according to claim 33, characterized in that said third modulator is a magneto-optical variable attenuator.
35. An optical repeater comprising at least a first optical fiber adapted to carry a first optical signal in a first direction, at least a first modulator connected to said first optical fiber and a supervisory unit associated to said first modulator, said supervisory unit being adapted to generate a first supervisory signal, said first modulator being adapted to superimpose said first supervisory signal on said first optical signal, characterized in that said optical repeater further comprises at least a first pump source connected to said first optical fiber, said first pump source being adapted to send on said first optical fiber a pump radiation in a second direction opposite to said first direction, said pump radiation being adapted to cause Raman amplification of said first optical signal on said first optical fiber.
36. An optical repeater according to claim 35, characterized in that said supervisory unit is associated to said first pump source.
37. An optical repeater according to claim 35 or 36, characterized in that it further comprises a second optical fiber adapted to carry a second optical signal in a second direction opposite to said first direction and at least a second modulator connected to said second optical fiber.
38. An optical repeater, according to claim 37, characterized in that said supervisory unit is associated to said second modulator and said second

modulator is adapted to superimpose said first supervisory signal on said second optical signal.

- 5 39. An optical repeater according to any one of claims 37 or 38, characterized in that it further comprises at least a second pump source connected to said second optical fiber, said second pump source being adapted to send on said second optical fiber a pump radiation in a direction opposite to said second direction, said pump radiation being adapted to cause Raman amplification of said second optical signal.
- 10 40. An optical repeater according to claim 39, characterized in that said supervisory unit is associated to said second pump source.
41. An optical repeater according to any one of claims 35 to 40, characterized in that said first supervisory signal comprises at least an information signal on the operating state of said first or said second pump source.
- 15 42. An optical repeater according to any one of claims 35 to 41, characterized in that it further comprises a first photodetector connected to said first optical fiber, said first photodetector being adapted to receive at least a portion of said first optical signal and transform said portion of first optical signal in an electrical signal.
- 20 43. An optical repeater according to claim 42, characterized in that said supervisory unit is associated to said first photodetector, so as to discriminate a second supervisory signal carried by said first optical signal.
- 25 44. An optical repeater according to any one of claims 37 to 43, characterized in that it further comprises a second photodetector connected to said second optical fiber, said second photodetector being adapted to receive at least a portion of said second optical signal and transform said portion of second optical signal in an electrical signal.
45. An optical repeater according to claim 44, characterized in that said supervisory unit is associated to said second photodetector, so as to discriminate a third supervisory signal carried by said second optical signal.

46. An optical repeater according to any one claims 35 to 45, characterized in that said first or said second modulator is a lithium niobate modulator.
47. An optical repeater according to any one of claims 35 to 45, characterized in that said first or said second modulator is a semiconductor modulator.
- 5 48. An optical repeater according to any one of claims 35 to 45, characterized in that said first or said second modulator is a tunable band-pass filter.
49. An optical repeater according to any one of claims 35 to 45, characterized in that said first or said second modulator is a variable optical attenuator.
- 10 50. An optical repeater according to claim 49, characterized in that said variable optical attenuator is a magneto-optical variable attenuator.
51. An optical repeater according to any one of claims 35 to 45, characterized in that said first or said second modulator comprises an optical amplifier, and in that said first supervisory signal is adapted to modulate a gain of said optical amplifier.
- 15 52. An optical repeater according to claim 51, characterized in that said optical amplifier is an erbium-doped fiber amplifier.
53. An optical repeater according to claim 52, characterized in that said erbium doped fiber amplifier comprises at least one erbium-doped fiber and at least a further pump source adapted for emission of a pumping radiation for said
20 erbium doped fiber, said supervisory unit being associated to said further pump source, so that said first supervisory signal is adapted to modulate said pumping radiation for said erbium-doped fiber.
54. An optical repeater according to claim 51, characterized in that said optical amplifier is a semiconductor amplifier
- 25 55. An optical repeater according to claim 51, characterized in that said optical amplifier is a co-propagating Raman amplifier.
56. An optical repeater according to claim 55, characterized in that said co-propagating Raman amplifier comprises at least a further pump source being adapted to send on said first optical fiber a pumping radiation in said first

direction or on said second optical fiber a pumping radiation in said second direction, said pumping radiation being adapted to cause Raman amplification of said first or of second optical signal, said supervisory unit being associated to said further pump source, so that said first supervisory signal is adapted to
5 modulate said pumping radiation for Raman amplification.

57. A method for supervising an optical transmission system comprising an optical link between at least a first and a second terminal station, said method comprising:

- transmitting a first optical signal on said optical link in a first direction;
- 10 - superimposing a first supervisory signal on said first optical signal;

characterized in that said method further comprises:

- sending on said optical link a pump radiation in a second direction opposite to said first direction, so as to cause Raman amplification of said first optical signal and of said first supervisory signal superimposed
15 on said first optical signal.